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ABSTRACT

In fall 1980, a self-paced, individualized, mastery learning approach was adopted at Hibbing Community College for four chemistry courses in order to increase student performance and success and to provide scheduling flexibility for adult students with outside commitments. While both the traditional approach used prior to fall 1980 and the new approach relied primarily upon a lecture-laboratory format, there were certain testing and procedural differences. In the traditionally taught courses, students participated in eight or nine labs, which they completed once for a grade, and took in-class exams. Under the new approach, the number of labs was reduced to five to allow for more one-on-one interaction, students repeated the labs until they had performed them correctly, and students took exams on their own time. A comparison of grades and completion rates under the two instructional approaches reveals that student performance increased dramatically under the new instructional approach, but that course completion rates tended to be lower. Students who were enrolled in Chemistry 111 (Aspects of Chemistry) tended to have better grades and completion rates than those in Chemistry 124 (General Principles of Chemistry) in both the individualized and traditional classes. (HB)

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A Limited Self-Paced, Individualized, Mastery Learning Program

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JC 820 220

A Limited Self-Paced, Individualized, Mastery Learning System

Jerry L. Krause

Encouragement to design a limited self-paced, individualized, mastery learning system was received from Professor John Roueche's presentation at a northeastern Minnesota community college staff development day and his book A Modest Proposal: Students Can Learn. The Laboratory program was patterned after that designed by the chemistry faculty at Hamline University. The reasons for attempting this innovation are evident in the following objectives for the innovation: (1) increase student performance, (2) increase student success, (3) to provide flexibility so that adults with full-time lives would have a chance of succeeding in chemistry.

Figure 1 shows the descriptions for the courses in which this method of instruction is being used. Chemistry 111 and 124 will be examined in most detail since these courses have the greater number of students.

Figure 2 compares the traditional format with the innovative one.

Figure 3 presents the statistical data for Chemistry 111 and Figure 4 presents that for Chemistry 124. The new format was first used fall quarter, 1980. After this first quarter, one procedural adjustment was made in both courses. The pace of laboratory work was tied to that of testing and tests not taken by the slow schedule (which allows the class to be completed over a two-quarter period) were recorded as zero. This change contributed to the increased success in Chemistry 111 for Spring 1981 and Fall 1981. Because at our school there is a significant number of students who register, but put forth such little effort that it is difficult to say they have honestly tried, a second rate of success is calculated which only counts students attempting the class who take more one-fourth of the exams.

It is obvious that the student performance did dramatically increase. It is equally obvious that the rate of success did not, although it should be recognized that in Chemistry 111 the rate is presently up to previous levels. It cannot be stated unequivically the increase in student performance in Chemistry 111 is due to the method of instruction as the text book was also new Fall 1980. However, in Chemistry 124 the method of instruction must be the reason for the improved performance since the same text, similar texts, and a higher grading scale were used. For the first time students who did not succeed (complete) could not say the chemistry was beyond them as they had average or above scores on tests taken.

Figure 5 shows the basic laboratory program for Chemistry 111 and 124. As stated earlier, only when the laboratory was done correctly was it completed. Besides being a confidence builder, the mastery of these basic techniques creates the true image of scientific research; it only has value if it is done right.

That the students had troule with the freedom given to them is understandable. It is not possible to typify the student who had the greatest difficulty. Some young (18-20 year old) and some older (25-50) finished the course before the end of one quarter. A similar percentage of each group didn't finish the course. It is obvious the Chemistry 111 students seem to do better than the Chemistry 124 students. This is not so understandable. It is now recognized that it was an error not to offer three hours per week of lecture in Chemistry 124 as was done in Chemistry 111, but even this does not explain why the Chemistry 111 students (a majority never had chemistry course) coped much, much better than the Chemistry 124 students in the same individualized laboratories.

Figure 6 offers a possible explanation of the Chemistry 124 students' lack of success. It is possible that they do not have sufficient time to do the work

required by this course. Not only are they average 16.7 credits, but these credits most likely are in those courses considered to be most academically difficult.

In conclusion, the limited self-paced, individualized, mastery learning system reported in this report does give most students with desire and a willingness to work a better opportunity to realize their potential than did the traditional method of instruction.

Figure 1

Chem 111 Aspects of Chemistry

An introductory course in chemistry consisting of topics in general and organic chemistry requiring a minimum of mathematics. Emphasis is on contemporary application.

Designed as a liberal arts offering for general education and allied health science student needing four credits in chemistry. Lecture: 3 hours per week; Lab: 2 hours per week; Recitation: 1 hour per week. Prerequisite: None. A Chemistry 124 - Chemistry III sequence may not be taken to meet the laboratory science requirement.

Chem 112 Aspects of Chemistry

Continuation of Chemistry III consisting of selected topics in organic, consumer and biological chemistry and contemporary technical problems.

Designed as a liberal arts offering for general education and allied health students needing eight credits in chemistry.

Chem 124 General Principles of Chemistry

Basic concepts of Chemistry, atoms, molecules, and ions; chemical formulas and equations, thermochemistry, physical behavior of gases, electronic structure of atoms, chemical bonding, physical properties of molecular substances; nature of organic compounds; liquids and solids; changes in state.

Designed for those students whose program requires two or three quarters of introductory chemistry. These students typically are in health related programs, engineering, or science. Lecture: 4 hours per week; Lab: 2 hours per week; Recitation: 2 hours per week. Prerequisites. High school algebra or equivalent.

Chem 125 General Principles of Chemistry

Solutions; colloids; chemical kinetics; chemical equilibrium; participation reactions; acids and bases; oxidation and reduction.

Designed for those students whose program requires two or three quarters of introductory chemistry. These students typically are in health related programs, engineering, or science. Lecture: 4 hours per week; Lab: 3 hours per week; Recitation: 1 hour per week. Prerequisite: Chemistry 124 or equivalent.

Figure 2

	Traditional	Self-paced, individualized, mastery learning system
Ch 111	30-50 minute lectures	30-50 minute lectures
	8 or 9 - 110 minute laboratories (24 student limit)	5 - Individualized laboratories More time allotted for one on one interaction.
	10-50 minute recitations (24 student limit)	
	Tests taken once at scheduled time during lecture periods	Tests taken outside of lecture period at students' timing. May be repeated once.
	Laboratories done once; graded on scale 0-20.	Laboratories repeated until done correctly.
Ch 124	40-50 minute lectures	10-50 minute lectures
	10-50 minute lecture recitations	5 - Individualized laboratories and final
	8 or 9 - 110 minute laboratories (24 student limit)	Much time allotted for one on one interaction.
	10-50 minute laboratory recitations	
	Tests taken once at scheduled time during lecture periods.	Tests taken outside of lecture period at students' timing. May be repeated once.
	Laboratories done once; graded on scale 0-20.	Laboratories repeated until done correctly.

Figure 3

Chemistry 111

	(F-81)	(S-81)	(F-80)	('79)	('78)
Rate of Student Success (10th day)	32/44 (73%)	12/20 (60%)	31/58 (53%)	33/44 (75%)	29/48 (60%)
Rate of Student Success (more than ¼ work)	32/38 (84%)	12/13 (92%)	31/45 (69%)	33/39 (85%)	- - - - - -
Grades Earned:					
A	14	5	18	3	6
B	11	6	10	14	11
C	5	1	2	10	9
D	2	0	1	6	3
Average Percentage Scores of Students not Earning Credit	70%	76%	71%	48%	- - - - - - -
Percentage of Students earning Credit in one Quarter	50% (22/44)	50% (10/20)	36% (21/58)	82% (32/39)	60% (29/48)

Figure 4

Chemistry 124

	(F-81)	(F-80)	('79)	('78)
Rate of Student Success (10th day)	21/32 (66%)	30/57 (53%)	27/36 (75%)	40/51 (78%)
Rate of Student Success (more than ⅛ work)	21/29 (72%)	30/41 (73%)	27/35 (77%)	40/46 (87%)
Grades Earned				
A	6	14	3	6
B	7	14	10	9
C	5	2	10	15
D	3	0	4	10
Average Percentage Scores of Students not Earning Credits	71%	85%	53%	54%
Percentage of Students earning Credit in One Quarter	9% (3/32)	23% (13/57)	75% (27/36)	78% (40/51)

Figure 5

Laboratory

Balance

15 separate weighings

Liquid transfer

Solid transfer

Pipet & Volumetric Flask

Use of graduated pipet

Use of volumetric flask

Use of transfer pipet

Volume of gas as a function of temperature and graphing

Use of thermometer

Use of meter stick

Use of Bunsen burner

Analysis of data to find straight line plot

Possibilities: y vs x

y vs log x

log y vs x

log y vs log x

Titration

Make NaOH solution

Standardize NaOH solution

Determine equivalent weight of solid acid

Library Research

Primary article is partial requirement

Figure 6

Fall - 1981

Chem 111	12.9 credits	45% p.t.	15.5 hours/week
Chem 124	16.7 credits	50% p.t. 5% f.t.	16.6 hours/week

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